The North African Journal of Food and Nutrition Research: (2019)03;(05):164-71
https://doi.org/10.5281/zenodo.3344609

Original Article

OPEN ACCESS

eISSN: 2588-1582

THE NORTH AFRICAN JOURNAL OF FOOD AND NUTRITION RESEARCH

Contents lists available at
Journal homepage: https://www.najfnr.org

Association of Socioeconomic Status, Dietary Behavior, and Obesity among Moroccan Adults of the Region of Rabat: A Case-Control Study

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ARTICLE INFO

Article history:
Received 03 May 2019
Accepted 16 July 2019
Available online 24 July 2019

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Access this article online

Quick Response Code

https://doi.org/10.5281/zenodo.3344609

Article edited by:
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ABSTRACT

Background: The incidence of worldwide obesity is on the increase. Obesity is defined as an excessive accumulation of fat in the body. 39% of adults, aged 18 years and over, were overweight in 2016 and 13% were obese. **Aims**: To examine the association of dietary patterns, socioeconomic status, and the body mass index in Moroccan adults. **Methods and Material**: This is an analytical case-control study, conducted among obese (n=100) and non-obese (n=150) subjects, aged between 18 and 59 years old, when women represented 60% of participants. At recruitment, all anthropometric parameters were measured. The body composition was assessed by the use of impedance meter. Dietary habits were assessed using 24 hours' food recall and food frequency questionnaire. The results were analyzed using the Kolmogorov-Smirnov (K-S) and the chi-squared (χ^2-test) test and the percent distribution. **Results**: Our results showed that abdominal obesity and overall body fat (BF) percent were much prevalent among the obese group (BF% >30). There was a significant association between the lack of physical activity (p=0.002), educational level (p=0.001) and the risk of development of obesity. Concerning the age (p=0.06) and the gender (p>0.05) of the participants, there was no difference regarding these parameters and the risk of development of obesity (p>0.05). A strong relationship between marriage and the development of obesity was found, when 83.90% of the obese group were married, whereas 73.70% of the non-obese group were single (p<0.001). Concerning dietary assessment, our data revealed that the energy consumption of lipids slightly exceeds the recommended target. The major consumed foodstuffs by the obese group were oils and fats. **Conclusions**: The adult participants of the region of Rabat have an unbalanced body weight status resulting from an altered dietary behavior and from an altered socioeconomic profile that can lead to various health complications. Further studies are required on a large population aiming to develop effective strategies to fight the rapid increase of obesity.

Keywords: Obesity, body mass index, dietary behavior, socioeconomic status.

1. INTRODUCTION

Over the last years, the worldwide population has known a new leap concerning its eating habits, frequently assigned as "nutrition transition". This transition is characterized by a higher caloric diet, a less consumption of complex carbohydrates, and a reduced intake of fibers, fruits and vegetables [1]. Several studies (clinical, epidemiological, etc.) have highlighted the role of nutritional factors (integrating food) in the determinism of the main chronic diseases which had a significant human, social and economic cost among a society. Obesity is one of these diseases in which nutritional factors are involved [2]. Furthermore, the lack of physical activity leading to a decrease of energy expenditure, when combined with high caloric intake, can promote the development of obesity and a state of chronic inflammation [3]. The concern of obesity has become a public health issue affecting quality of life. It is well known that obesity is a major risk factor for numerous diseases and a variety of metabolic and medical complications [4,5], such as; cardiovascular disorders, type 2 diabetes, and some cancers, which in turn contribute to the mortality and morbidity [6,7].

According to the World Health Organization (WHO), since 1980, the worldwide prevalence of obesity has more than doubled (more than 70% of the adult population was obese or overweight), with significant increases in every region [8]. 39% of adults aged 18 years and over were overweight in 2016 and 13% were obese [9]. In Morocco, the obesity phenomenon has also propagated; referring to the results of the national survey on anthropometry, carried out by the High Commission for Planning in 2011, the incidence of obesity is affecting 3.6 million Moroccan adults, representing 17.9% of the population (21.2% in urban areas, 12.6% in rural areas). This is the case of 26.8% of women against 8.2% of men [10]. Another recent study (2016) conducted on 10.524 Moroccan adult participants has revealed that 23.2% was the prevalence of obesity in that population [11]. Considering the rapid rise of overweight and obesity among the population, an increasing number of studies have highlighted the role of dietary components in the development of obesity [12]; also excessive consumption of fat is well known to be considered in this etiology [13,14]. Besides sedentary behavior, socioeconomic factors play a role in the development of obesity too, especially in women which affect their eating behavior and then their body status [15,16]. Giving the background information mentioned above we aim, in the current study, to examine the relationship between dietary patterns, socioeconomic status, and the body mass index (BMI) in Moroccan obese and non-obese adults. To date, the non-such association has been fully investigated.

2. SUBJECTS AND METHODS

2.1. Study Design

2.1.1. Type and period of study

This is an analytical case-control study, carried out over a period of one year, between 2015 and 2016. The survey was designed to examine the association of dietary patterns, socioeconomic status and the BMI in Moroccan obese and non-obese adults.

2.1.2. Place of study

The study took place at the level of Nutrition Unit, Hygiene and Collectivity Medicine Ward of the Military Hospital of Instruction Mohammed 5th (M.H.I.M.5, Rabat-Morocco).

2.1.3. Subjects

Inclusion criteria: Participants (male and female, adults: age between 18 and 59 years old) were recruited from the group of patients visiting the Nutrition Unit for a general health check-up, during the consultation days, or women represented 60% of the participants. A total of 250 consenting participants, recruited for the present study, were divided into two groups according to their BMI: obese (BMI≥30 kg/m^2) and non-obese (18.5 kg/m^2≤BMI≤24.9 kg/m^2) in accordance with the WHO reference values [17].

Non-inclusion criteria: The non-inclusion criteria were chronic illnesses such as diabetes, hypertension, cardiovascular diseases, etc., smoking, pregnancy and breastfeeding §/or menopause situation aiming not to bias the results, since the relationship between obesity and these factors is well established [18-19]. Written and oral consents from all the participants were obtained for their involvement in the present study where they were assured about confidentiality and well informed on the procedure.

2.2. Data collection

Collection of data was conducted by filling out a set of questionnaires including identity information, anthropometry, physical activity, socioeconomic status, and data regarding dietary habits by using 24h dietary recall/food frequency assessment.

2.3. Anthropometric measurements

During the consultation days, while dressed in light clothing and without shoes, the body weight and height, for the participants with eligible criteria, were measured using a scale-stadiometer (Seca gmbh & Co. kg. Hamburg, Germany). The BMI was defined as the body weight (kg) divided by the height squared (m^2). Waist circumference (WC) was measured midway between the lowest ribs and the iliac crest in a horizontal plane, as to the hip circumference (HC); it was measured at the widest point

over the buttocks. Waist-to-hip ratio (WHR) was calculated as waist measurement divided by the hip measurement. Furthermore, we assessed the body composition especially the body fat and the physical activity level, using bio-impedance technology (BodyStat Quadscan 4000).

2.3.1. Dietary intake assessment

a. 24-hour food recall

Aiming to collect information about their eating habits, participants were invited to provide three random 24-hour food recalls on three different days of the week. This is the most commonly used method for assessing dietary intake [20]. That consists to estimate food consumption in the most precise way possible [21]. At the interview meeting, participants were not previously informed about the days of questioning, aiming not to affect their eating habits. They were asked to recall and describe qualitatively and quantitatively all food and beverages consumed during the 24 hours preceding the interview. To help participants afford the most accurate data possible, we opted for a method with three main steps; first, the participants were invited to list all food and beverages consumed in the last 24 hours. Second, they gave details about each consumption situation, regarding the items reported before (type, quantity, timing, and occasion). Third, they were asked to memorize any other food or detail that might have been forgotten [22].

Participants were assisted to approximate portion size and to be more accurate. Standard measurements utilized were:

- A photo notebook (SU.VI.MAX.) that constitutes a precious aid to improve the accuracy of the estimation of dietary intakes [23].
- A Food book: to estimate food consumption, contains pictures of food models usually consumed in Morocco; *[Aliments et Préparations Typiques de la Population Marocaine; by Khadija Elmoumni; Haute Ecole Lucia de Brouckère- CIRIHA-Département de Diététique et Nutrition Appliquée; 2008; Brussels, Belgium].*

The weight equivalence (in grams) of consumed food was obtained throughout food quantification table, available in the corresponding manual, then the values were entered on the Nutrilog nutrition software (SAS, version 3.11), to be converted into energetic nutrients (Proteins, lipids, and carbohydrates) and other elements on the survey period. All details about the average contribution of these nutrients in the total energy intake (TEI) for the given period (3 days) were calculated and values are expressed in percentages and grams.

b. Food consumption frequency

To determine participants' eating habits over an extended period of time, a food frequency questionnaire (FFQ) was used as part of the present study. The questionnaire estimated the consumption frequency of certain foods during the last month preceding the interview. Participants completed the questionnaire after the 24-hour recall. They had to mention how many times (never, number of times per month, week or day) have consumed the foods presented on the list [24].

c. Socioeconomic status

The data on socioeconomic profile and living environment were collected using an appropriate questionnaire including information about level of education, marital status, family size and the estimated food budget coefficient (defined as the budget estimate devoted to food consummation, from the total monthly budget: less than half of the monthly budget, between 50% and 70% and more than 70% of the total budget).

2.4. Statistical analysis

The data entry was performed using Epi-Info software (version 3.5.4). The statistical analysis was conducted using SPSS software (Statistical Package for the Social Sciences) version 24. We tested the normality of each variable by one-sample Kolmogorov-Smirnov (K-S) test. The quantitative variables normally distributed were presented as means± standard deviation (SD); those none normally distributed were expressed on median [percentile 25, percentile 75]. The qualitative variables were expressed in percentages. The qualitative variables were compared by the Chi-square test. The degree of statistical significance was considered for $p<0.05$.

3. RESULTS

3.1. Subject characteristics

Table 1 summarizes the anthropometric characteristics of all the participants. The study included women with a percentage of 60% (n=150) and men (n=100). The participants were divided into two groups, based on their BMI: obese (n=100) with a median BMI of 34.67 kg/m^2 and non-obese (n=150) with a median BMI of 22.25 kg/m^2 ($p=0.01$). Both groups had the same age ($p=0.06$) with a median of 32 years. The mean age of the obese group was 36±9.25 years and that of the non-obese group was 30.35±9.49 years. For the waist-to-hip ratio (WHR), no significant difference was observed between obese and non-obese group ($p=0.9$). For body fat percent (BF %), a significant difference was observed between the two groups ($p=0.02$), the median value and percentiles were

respectively 44.30 [40.50, 47.40] and 27.50 [21.20, 29.70] for obese and non-obese individuals. Concerning physical activity, a significant association with the risk of obesity was observed (p=0.002), where 70.40% of obese subjects exhibit a very low rhythm and only 7.40 % with medium cadence. No difference was observed between genders (p>0.05) as shown in Table 1.

The socioeconomic status of the participants is reported in Table 2. A significant relationship between the major variables and the BMI of the participants was found. In fact, a significant correlation was observed between educational level and the BMI among the studied group (p=0.001). Further significant association was found regarding marital status, when 83.90% of the obese group were married, whereas 73.70% of the non-obese group were single (p=0.000). Finally, no difference was noticed concerning household size (p=0.2), coefficient food budget (p=0.232) and the risk of obesity. No difference was observed between genders (Table 2).

Table 1: Anthropometric parameters of the obese and the non-obese participants

Parameters	Obese (n=100)	Non-Obese (n=150)	*P-value*
Age (years)	38.00 [31.00 , 43.00]	27.50 [23.00 , 36.00]	0.06
Weight (kg)	93.65±13.48	62.13±11.42	0.00001
Height (cm)	161.00 [157.00,164.00]	169.00 [162.00 ,175.00]	0.12
BMI (kg/m^2)	34.67 [31.64 , 38.39]	22.25 [20.69 , 24.01]	0.01
WC (cm)	108.89±10.75	84.68±8.45	0.02
HC (cm)	120.52±8.68	100.92±5.90	0.04
WHR	(*F*:0.89±0.07; *M*:1.04±0.08)	(*F*:0.83±0.03; *M*:0.86±0.08)	0.9
BF%	44.30 [40.50 , 47.40]	27.50 [21.20 , 29.70]	0.02
Physical activity (%)			0.002
Very Low	70.40	11.1	
Low/Medium	22.20	77.8	
Medium	7.40	11.1	

*Results are presented as means ± standard deviation for normally distributed variables and on median [percentile 25, percentile 75]; p values are for the comparison between obese and non-obese subjects and were determined by using Chi-square test; Abbreviation: BMI: Body Mass Index, WC: waist circumference, HC: hip circumference, WHR: waist-to-hip ratio, F: female, M: male and BF%: body fat percent.

Table 2: Socioeconomic characteristics of the studied participants

Parameters	Obese (n=100)	Non Obese (n=150)	*P-value*
Educational level (%)			0.001
Illiterate	19.70	00.00	
Primary	17.60	5.00	
Secondary	39.20	22.50	
University	23.50	72.50	
Marital status (%)			*0.000*
Single	14.30	73.70	
Married	83.90	23.70	
Widowed	1.80	2.60	
Estimated food budget coefficient (%)			0.232
<50% of the monthly budget	38.60	40.00	
50%-70%	50.00	60.00	
>71%	11.40	00.00	
Family size	4.00 [4.00, 6.00]	4.00 [2.00, 6.00]	0.2

Results are presented as proportion; P values are for the comparison between obese and non-obese subjects and were determined by using the Pearson Chi-square test.

Table 3: Nutritionals intakes of both obese and non-obese groups according to the 24h dietary recall

	Obese (n=100)	Non-Obese (n=150)	*p-value*
Energy intake (kcal)	1850	1697	0.12
Lipids (g)	67.27	58.80	0.27
Proteins (g)	63.26	68.10	1.00
Carbohydrates (g)	213.47	193.00	0.12
Lipids (% of TEI)	33.80	33.00	0.51
Proteins (% of TEI)	14.88	17.00	0.48
Carbohydrates (% of TEI)	48.98	48.20	0.83
Diverse (%)	2.32	1.70	0.82

TEI: Total energy intake,
Intakes based on 3-days dietary recall (food sources only).

3.2. Dietary assessment

In Table 3, are presented the results of the 24h dietary recall intake, where carbohydrates and lipids were the main macronutrients consumed. No significant difference between the two groups and in both genders (p>0.05) was found. Figures 1 and 2 show the frequency of consumption of foods (in percentage) that are mostly consumed by the Moroccan population. Analysis of the dietary habits of our participants showed that, oils and fats were the major

consumed products by the obese group, with 18% of total consumed food, whereas cereals and legumes represented 20% in the non-obese group. Fruits and vegetables come in the second place and represented the same percentage (17%) in both groups. Sugars represent 12% in the first group and 10% in the second one.

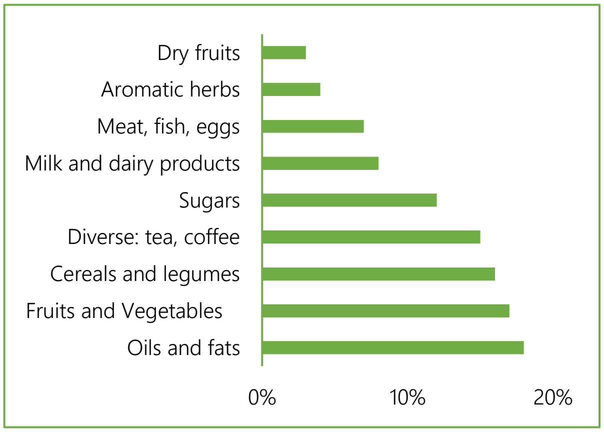


Figure 1: Food frequency consumption in the obese group

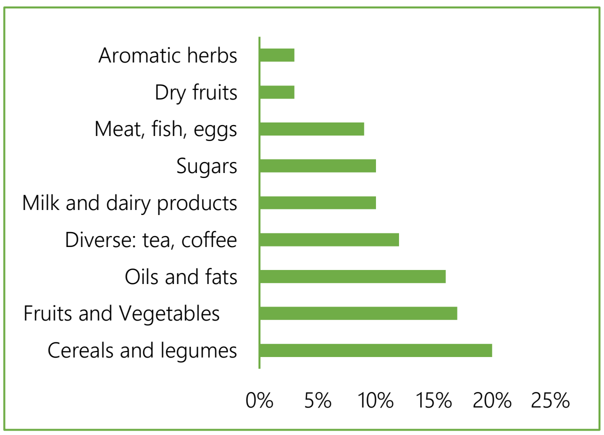


Figure 2: Food frequency consumption in the non-obese group

4. DISCUSSION

The study was designed to investigate the relationship between socioeconomic status, eating behavior, and the development of obesity in obese (case) and non-obese (control) Moroccan subjects. Our results showed that there was a highly significant difference between the two groups, regarding their anthropometric measurements ($p<0.01$). In the current study, the prevalence of abdominal obesity was considerable as the prevalence of overall obesity for the obese group who exhibited class II of obesity (BMI≥35 kg/m^2, BF %> 30) [17,25]. The WHR defined an abdominal obesity (≥ 0.90 cm for men and ≥ 0.85 cm for women; WHO guidelines), in which the risk of metabolic complications, as well as serious health issues, is substantially increased, because of the fat distribution [26]. This last indicator has also been shown to be a greater predictor of cardiovascular diseases [27].

A highly significant association was found between the lack of physical activity and the risk of developing obesity. Where 70.40% of obese subjects had a very low level, whereas 7.40 % had a medium level. This, it is compatible with the finding of a previous survey indicating that only 0.8% of Moroccans are practicing sport [28]. Results from another study showed a linear association of physical activity and other health status like obesity, cardiovascular disease, diabetes [29]. Indeed, several studies reported that, the lack of physical activity does not only lead to overall/abdominal obesity, but also is associated with increased indicators of systemic inflammation [30,31].

Socioeconomic status is considered to be associated with overweight and obesity risk, that is generally measured by the educational level, income, marital status, etc. Results from the 1996 Health Survey for England revealed the association of a higher risk of obesity and the lower educational/economic level and a lower occupational status [32]. In our study, the educational level plays a significant role in the development of obesity ($p=0.001$) among Moroccan subjects, when 19.60% of the obese group were illiterate, whereas 72.50% of the non-obese group had a university degree. These results agree with those from a national survey that revealed the predominance of obesity among adults with low levels of education [28] and disagree with a Polish study conducted in southwestern region, in which the educational level did not have a significant role [33]. Another significant association was found concerning marital status, when 83.90% of the obese group were married, whereas 73.70% of the non-obese group were single ($p=0.000$). Finding from other studies have highlighted the strong association of marriage and the development of obesity [34,35]. Indeed, there was no difference regarding household size, coefficient food budget and the development of obesity ($p>0.05$). Also, no difference was observed between genders.

In the present study, we assessed the eating habits of our participants, through the 24h dietary recall and a food frequency questionnaire. We calculated the frequency of consumption of all food patterns generally consumed by Moroccan population. Our results showed that the carbohydrates and lipids were the main macronutrients consumed and represent respectively, 48.98% and 33.80% of total energy intake in the obese group and 48.20% and 33.00 % of TEI in the non-obese group. Compared to the nutritional guidelines (FAO/WHO), it seems clear that the energy needs of carbohydrates for both groups are not sufficiently covered, while their energy needs of lipids slightly exceed the recommended target [36]. Results from

two other studies indicate that the fat intakes of a population exceed by 10% the recommendations, and most of individuals do not consume sufficient vegetables/fruits or fibers [37,38]. Moreover, the finding from the frequency questionnaire showed that the major consumed foodstuffs, by the obese group, were oils and fats, contrary to the non-obese group, where the cereals and legumes were the main consumed. These results show the difference observed in the quality of food usually ingested. In general, when comparing the nutritional intake of both groups, we did not observe any significant difference, even between genders ($p>0.05$).

Our survey provides baseline data on the dietary intake of the target population. It seems prudent to increase the implementation of effective strategies to combat obesity, taking into consideration the requirements of a better understanding of the associated risk factors through the study of physiological and genetic mechanisms in a large population.

5. CONCLUSION

To the best of our knowledge, the current study constitutes the first case-control study identifying the relationship between socioeconomic status, dietary behaviors and the high levels of BMI among a group of Moroccan adults that showed an unbalanced weight status resulting from an altered dietary behavior and an altered socioeconomic profile. We do believe that our results will lead to a better understanding of the implication of some factors in the development of obesity in Moroccan population. Further research is required on the effect of obesity on health taking into consideration the socioeconomic impact.

List of abbreviations

WHO: world health organization, BMI: body mass index, WC: waist circumference, HC: hip circumference, WHR: waist to hip ratio, TEI: total energy intake, FFQ: food frequency questionnaire, SPSS: Statistical Package for the, Social Sciences, SD: standard deviation, BF%: body fat percent, F: female, M: male, FAO: Food and Agriculture Organization, CEBR: Committee of Ethics and Biomedical Research.

Ethics approval

The present study was approved by the Committee of Ethics and Biomedical Research (CEBR, folder number: 38/15) of the Faculty of Medicine and Pharmacy of Rabat, in accordance with the ethical standards of the institutional and/or national research committee and with the 1964 Helsinki declaration and its later amendments or comparable ethical standards. Before undertaking the protocol, all objectives and modalities were clarified to the participants by attending physician. Written and oral consents were therefore willingly obtained.

Informed consent

Informed consent was obtained from all individual participants included in the study.

Acknowledgement

The authors wish to thank kindly all the participants in this study for their consent, time and energy. They also thank the staff of the Nutrition Unit, Hygiene and Collectivity Medicine Ward at the Military Hospital of Instruction Mohammed 5th (M.H.I.M.5, Rabat-Morocco) for their assistance and support.

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Cite this article as: Bajit H, Benkirane H, Bouziani A, Mouzouni F.Z, Bouaiti E, Belghiti H, Mrabet M, Barkat A, Aguenaou H. Association of socioeconomic status, dietary behavior, and obesity among Moroccan adults of the region of Rabat: a case-control study. *Nor. Afr. J. Food Nutr. Res.* January - June (2019);03 (05):164-71. https://doi.org/10.5281/zenodo.3344609